

XII Acronyms and Abbreviations

°C	Degrees Celsius	Ag	Silver
°F	Degrees Fahrenheit	AgCl	Silver chloride
1-D, 1D	One-dimensional	AIChE	American Institute of Chemical Engineers
2-D, 2D	Two-dimensional	AIM	Application interface module
3-D, 3D	Three-dimensional	AIP	Analytical Interatomic Potential (computer model)
1Q	First quarter of the fiscal year	AIP	American Institute of Physics
2Q	Second quarter of the fiscal year	AirCred	Air Quality Credits calculation software tool developed by ANL
3Q	Third quarter of the fiscal year	Al	Aluminum
4Q	Fourth quarter of the fiscal year	AlCl ₃	Aluminum chloride
6F	Hexafluorinated (biphenol A) sulfonated poly(arylene ether sulfone)	AlH ₃	Aluminum hydride; alane
Ω-cm ²	Ohm-square centimeter	Al ₂ O ₃	Aluminum oxide
A	Ampere, amp	AM1	Austin Model 1
Å	Angstrom	AM 1.5	Air Mass 1.5 solar illumination
AB	Ammonia borane	AMRL	Active magnetic regenerative liquefier
ABMS	Agent-based modeling and simulation	AMRR	Active magnetic regenerative refrigerator
ABPBI	Poly(2,5-benzimidazole)	ANL	Argonne National Laboratory
A/cm ²	Amps per square centimeter	ANS	American Nuclear Society
AC	Alternating current	ANSI	American National Standards Institute
AC	Activated carbon	APCI, APCi	Air Products and Chemicals, Inc.
A/C	Anode/cathode	API	American Petroleum Institute
ACR	Autothermal cyclic reforming	APR	Aqueous-phase reforming
ACS	American Chemical Society	APS	Arizona Public Service
ACT	Alameda Contra Costa Transit	APS	American Physical Society
A-D	AC-DC (alternating current - direct current), used to describe a converter	APU	Auxiliary power unit
ADG	Anaerobic digester gas	Ar	Argon
ADM	Archer Daniels Midland Company	As	Arsenic
ADRY	Acceleration of the deactivation reactions of the water-splitting system Y	ASCM	Automotive System Cost Model, a spreadsheet model developed to estimate the costs of advanced technology vehicles and their components based on PSAT model outputs
AECP	Association of Energy Conservation Professionals	ASES	American Solar Energy Society
AEESM	Advanced electrical energy storage module	a-Si	Amorphous silicon
AEET	Alternative energy education technology	ASIC	Application-specific integrated circuit
AEM	Analytical electron microscopy	a-SiGe	Amorphous silicon germanium
AEO2003	Annual Energy Outlook 2003	ASM	American Society of Metals
AER	Absorption-enhanced reforming	ASM	ASM International - the Materials Information Society
AES	Auger electron spectroscopy		
AFB	Air Force Base		
AFM	Atomic force microscopy		
AFRL	Air Force Research Laboratory		
AFV	Alternative fuel vehicle		

ASME	American Society of Mechanical Engineers	BPS	Ballard Power Systems
ASMSS	Anode side membrane support structure	BPSH	Biphenyl sulfone H form
ASPDS	Automated spray pyrolysis deposition system	BPSH-30	Biphenyl sulfone H form, 30% molar fraction of disulfonic acid unit (30% level of sulfonation)
ASR	Area-specific resistance	Br	Bromine
ASTM	American Society for Testing and Materials	Br ₂	Diatomic bromine
at%, at.%	Atomic percent	BSE	Back scattered electron
ATCC	American Type Culture Collection	BTD	Best to date
ATG	Adenine,Thymine,Guanine, the 3 base combinations that indicate the first translatable amino acid on the DNA molecule	BTU, Btu	British thermal unit(s)
atm	Atmosphere	C	Carbon
ATMI	Advanced Technical Materials Incorporated	C	Coulomb
ATP	Adenosine triphosphate	Ca	Calcium
ATR	Autothermal reformer; autothermal reforming	CaBr ₂	Calcium bromide
Au	Gold	C&C	City and County of Honolulu
AuS	Gold sulfide	CaCO ₃	Calcium carbonate
Avg	Average	CAD	Computer-aided design
B	Boron	CAE	Computer-aided engineering
Ba	Barium	CAN	Controller area network
barg	Bar gauge	CANMET	Canada Center for Mineral and Energy Technology
bcc	Body-centered cubic	CaO	Calcium oxide
Be	Beryllium	CaS	Calcium sulfide
BES	Basic Energy Sciences office within the DOE Office of Science	CATA	Centre Area Transit Authority
BET	Bruner, Emmett and Teller surface area analysis method	CbHS	Carbon-based Hydrogen Storage
BH ₄	Borohydride	CBS	Casa Bonita strain
Bi	Bismuth	cc	Cubic centimeter(s)
BN	Boron nitride	CCF	Complex coolant fluid
BNH	Dehydrogenated ammonia-borane	cc/g cat/hr	Cubic centimeter(s) per gram catalyst per hour
BNL	Brookhaven National Laboratory	CCHSS	Complex Compound Hydrogen Storage System
B ₂ O ₃	Boron oxide; diboron trioxide	CCM	Catalyst-coated membrane
BOL	Beginning of life	Cd	Cadmium
BOP, BoP	Balance-of-plant	CD	Compact disk
bp	Base pair	CDC	Carbide-derived carbon
BP	British Petroleum	CdS	Cadmium sulfide
BPM	Brushless permanent magnet	cDNA	Complementary DNA
BPPPO	Biphenol-based phenyl phosphine oxide	CDO	Code development organization
BPPPO-35	Biphenol-based phenyl phosphine oxide copolymer, 35% molar fraction of disulfonic acid unit (35% level of sulfonation)	Ce	Cerium
		CEA	Commissariat a Energie Atomique
		CEC	California Energy Commission
		CEM	Compressor/Expander/Motor
		CeO ₂	Ceric oxide
		Cermet	Combination of ceramic and metal
		CERT	Committee on Energy Research and Technology
		CESI	Catalytica Energy Systems, Inc.
		CF	Carbon fiber
		CF	Constant flow

CFD	Computational fluid dynamics	CS	Chemically stabilized
cfm	Cubic feet per minute	CS	Ceramic support
CGA	Compressed Gas Association	Cs	Cesium
CGO	Cerium gadolinium oxide	CSA	Canadian Standards Association
CH ₂	Compressed hydrogen gas	CSA	Cell stack assembly
CH ₄	Methane	CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
C ₂ H ₄	Ethylene		
C ₂ H ₆	Ethane		
C ₃ H ₈	Propane	CSMP	Cabot Superior MicroPowders
CHARM	Cost-effective High-efficiency Advanced Reforming Module	CSR	Catalytic steam reforming
		CSTT	Codes and Standards Tech Team
CHES	Corral Hollow Experimental Station	CTE	Coefficient of thermal expansion
Chl	Chlorophyll	CTO	Conductive transparent oxide
CHP	Combined heat and power	CTV	Chevron Technology Ventures LLC
CI	Compression ignition	Cu	Copper
CIGS	Copper-indium-gallium-diselenide	CU	University of Colorado
CIS	CuInSe (alloy of copper, indium, and selenium)	cu.yd.	Cubic yard(s)
		CuO	Cupric oxide, copper(II) oxide
Cl	Chlorine	Cu ₂ O	Cuprous oxide
CLV	City of Las Vegas	CUTE	Clean Urban Transport for Europe
cm	Centimeter	CV	Cyclic voltammetry; cyclic voltammogram
cm ²	Square centimeter		
CMDR	Coupled magnetization-demagnetization refrigerant	CVD	Chemical vapor deposition
		CVS	Chemical vapor synthesis
CMS	Carbon molecular sieve	CWRU	Case Western Reserve University
CMU	Carnegie Mellon University	CY	Calendar year
CNG	Compressed natural gas	CZO	Ceria-zirconia
CNP	Combinatorial nanoparticle	d	Day(s)
CNT	Carbon nanotube	D ₂	Deuterium
CO	Carbon monoxide	DAE	Diels-Alder ether
Co	Cobalt	dB(A)	Decibel(s)
CO ₂	Carbon dioxide	DC	Direct current
CoE	Center of Excellence	DCEC	Delaware County Electric Cooperative, Inc.
COF ₂	Carbonyl fluoride		
COS	Carbon oxysulfide; carbonyl sulfide	DDT	Deflagration-to-detonation transition
CoTMPP	Cobalt tetramethoxyphenyl porphyrin	DFMA	Design for Manufacture and Assembly
CoTPP	Cobalt tetraphenyl porphyrin	DFT	Density functional theory
CO _x	Oxides of carbon	DFT-GGA	Density functional theory - gradient generalized approximation
CPC	Compound parabolic concentrator		
CpI	Clostridium pasteurianum [FeFe]-hydrogenase	DGAC	Dangerous Goods Advisory Council
		DI	Deionized
c.p.s.	Counts per second	dL/g	Deciliters per gram
CPSS	Combinatorial powder synthesis system	DMC	Direct manufactured cost
		DMFC	Direct methanol fuel cell
CP-Ti	Commercially pure titanium	DNA	Deoxyribonucleic acid
Cr	Chromium	DOD	Depth of discharge
CRBJT	Combined reverse-Brayton Joule-Thompson	DOD	U.S. Department of Defense
		DOE	U.S. Department of Energy

DOS	Density of states	EPR	Electron paramagnetic resonance
DOT	U.S. Department of Transportation	ES	Energy storage
DRIFTS	Diffuse reflectance infrared Fourier transform spectroscopy	ESD	Electro-static discharge
DRS	Direct recoil spectroscopy	ESR	Electron spin resonance
DSC	Differential scanning calorimetry	EtOH	Ethanol
DVHS	Differential volumetric hydrogen storage	eV	Electron volt
DVMT	Daily vehicle miles traveled	EW	Enthalpy wheel
e ⁻	Electron	EW	Equivalent weight
E	Potential	EXAFS	Extended x-ray absorption fine structure analysis
E _{1/2}	Half-wave potential	F	Fluorine
E _a	Activation energy	F ⁻	Fluorine ion
EC	European Community	FC	Fuel cell
ECA	Electrochemical area	FCB	Fuel cell bus
ECC	Electrochemical compressor	FCCP	Carbonyl cyanide m-chlorophenylhydrazone
ECE	Economic Commission for Europe	FCE	FuelCell Energy
ECS	Electrochemical Society	FCFP	FreedomCAR and Fuel Partnership
ECSA	Electrochemical surface area	FCV	Fuel cell vehicle
ECTOS	Ecological City Transport System (Iceland)	Fd	Ferredoxin
EDAX	Manufacturer of energy dispersive X-ray hardware and software	FE	U.S. DOE Office of Fossil Energy
EDC	Energy distribution curve	Fe	Iron
EDM	Electrical discharge machining	Fe ₂ O ₃	Ferric oxide
EDS	Energy dispersive x-ray spectroscopy	FEA	Finite element analysis
EDTA	Electric Drive Transportation Association	FEP	Fluorinated ethylene propylene; Teflon [®]
EDX	Energy dispersive x-ray analysis	FER	Fluoride emission rate
EEA	Energy & Environmental Analysis, Inc.	FERC	Federal Energy Regulatory Commission
EERE	U.S. DOE Office of Energy Efficiency and Renewable Energy	fg-ELAT	Fine gradient ELAT
EESM	Electrical energy storage module	FGHA	Forming gas hydrogen electrode
EGR	Exhaust gas recirculation	FHWA	Federal Highway Administration
EIA	Energy Information Administration of the U.S. Department of Energy	FIB	Focused ion beam
EIS	Electrochemical impedance spectroscopy	FLC	Flowering Locus C
ELAT [®]	Registered Trademark of De Nora North America, Inc., covers GDLs and GDEs	FMEA	Failure modes and effects analysis
EMC	Electromagnetic compatibility	¹⁹ FNMR	¹⁹ Fluorine nuclear magnetic resonance
EMI	Electro magnetic interference	FP	Fuel processor
EMTEC	Edison Materials Technology Center	fpm	Feet per minute
Ep	Peak potential	FPS	Fuel processing system
EPA	U.S. Environmental Protection Agency	FRP	Fiber-reinforced polymer
EPD	End point detection	FRS	Functional requirement specifications
		F-SPEEK	Fluorosulfonic acid of polyetheretherketone
		FST	FuelSell Technologies
		ft	Feet
		ft ²	Square feet
		ft ³	Cubic feet
		FTA	Federal Transit Administration

FT-IR, FTIR	Fourier transform infrared	GJ	Gigajoule(s)
FTIR-ATR	Fourier transform infrared attenuated total reflection	g/kW	Gram(s) per kilowatt
FTP	Federal Test Procedure	GLY	Glycerol
fWGS	Forward water-gas shift	GM	General Motors
FY	Fiscal year	gm	Gram(s)
G	Graphite	gm/day	Gram(s) per day
g	Gram	g/min	Gram(s) per minute
g/cc	Grams per cubic centimeter	GNF	Graphite nanofiber
g/min	Grams per minute	GPa	Gigapascal(s)
g/s	Grams per second	GPS	Global positioning system
Ga	Gallium	GREET	Greenhouse Gas Energy and Emissions in Transportation model
GaAs	Gallium arsenic	GRPE	Working Party on Pollution and Energy
GADDS	General area diffraction system	GSAS	General Structure Analysis System
gal	Gallon	GTI	Gas Technology Institute
GAMA	Gas Appliance Manufacturers Association	GTR	Global Technical Regulations
GAMS	Generalized Algebraic Modeling System, a commercially available software designed for linear and non-linear optimization	GV	Gasoline vehicle
GaP	Gallium phosphide	GWe	Gigawatt(s) electric
GC	Gas chromatograph	h	Hour(s)
GC	Glassy, or vitreous carbon; a pure carbon that is amorphous (non-crystalline)	H	Hydrogen
GCMC	Grand Canonical Monte Carlo	H+	Proton
GC/MS	Gas chromatograph/Mass spectroscopy	ΔH	Enthalpy
GC5T	GenCore 5T platform prototype back-up fuel cell design for telecommunications	H ₂	Diatomic hydrogen
GCtool	Software package developed at ANL for analysis of fuel cells and other power systems	H ₂ A	Hydrogen Analysis project sponsored by DOE
Gd	Gadolinium	HAD	Hydrogen adsorption/desorption
GDC	Gadolinium-doped ceria	HAMMER	Hazardous Materials Management and Emergency
GDE	Gas diffusion electrode	HARC	Houston Advanced Research Center
GDL	Gas diffusion layer	HATCI	Hyundai-KIA America Technical Center Inc.
Ge	Germanium	HAZOP	Hazards and Operational Safety Analysis; Hazards and Operability Analysis
GE	General Electric	HBr	Hydrogen bromide
GES	Giner Electrochemical Systems, LLC	HBU	Hydrogen-based unit
GF	Glass fiber	HCG	Hydrogen Coordinating Group
GGA	Gradient generalized approximation	HCl	Hydrochloric acid
GGE, gge	Gasoline gallon equivalent	HClO ₄	Perchloric acid
GH ₂	Gaseous hydrogen	HCNG	Hydrogen-compressed natural gas
GHG	Greenhouse gas	HCO ₃ ⁻	Bicarbonate
GHSV	Gas hourly space velocity	HC&S	Hawaiian Commercial and Sugar Company
GIS	Geographic information system	He	Helium
		HER	Hydrogen evolution reaction
		HEV	Hybrid electric vehicle
		Hf	Hafnium
		HF	Hydrofluorhydric acid; hydrogen fluoride

HFCIT	Hydrogen, Fuel Cells and Infrastructure Technologies Program	HTF	Heat transfer fluid
HFCTF	Hawaii Fuel Cell Test Facility	HTFC	High-temperature fuel cell
HFI	Hydrogen Fuel Initiative	HTGR	High-temperature gas-cooled reactor
HFR	High-frequency impedance; high-frequency resistance	HTHX	High-temperature heat exchanger
HFSF	High-Flux Solar Furnace	HTM	High-temperature membrane
HFSS	High-Flux Solar Simulator	HTM	Hydrogen transport membrane
HGM	Hydrogen Generation Module	HTPSS	High-throughput photoelectrochemical screening system
HGMS	Hollow glass microsphere	HTS	High-temperature shift
HHV	Higher heating value	H2USA	Hydrogen Technology Learning Centers (for CA, FL, and NY)
HI	Hydrogen iodide	HVAC	Heating, ventilation and cooling
HIA	Hydrogen Implementing Agreement	HWSS	Hardwired safety system
H ₂ ICE	Hydrogen-fueled internal combustion engine	HX	Heat exchanger
HiPCO, HiPCo	High-pressure carbon monoxide	HyDS model	Hydrogen deployment system model
HIx	Blend of hydrogen iodide, iodine, and water	HyS	Hybrid sulfur
HMC	Hyundai Motor Company	HyTEC	Hydrogen Technology and Energy Curriculum
HMM	Hidden Markov Model	Hythane	Compressed hydrogen natural gas blend
HNEI	Hawaii Natural Energy Institute	Hz	Hertz
HNO ₃	Nitric acid	HZM	Hot zone module
H ₂ O	Water	I	Current
H ₂ O ₂	Hydrogen peroxide	I ₂	Diatomic iodine
HOMO	Highest occupied molecular orbital	IBAD	Ion beam assisted deposition
HOR	Hydrogen oxidation reaction	IBS	Ion beam sputtering
HP	High-pressure	IC	Internal combustion
Hp	Average pool height	ICAO	International Civil Aviation Organization
hp	Horsepower	ICC	International Code Council
HPA	Heteropolyacid	ICE	Internal combustion engine
HPE	Hybrid photoelectrode	ICEV	Internal combustion engine vehicle
HPLC	High performance liquid chromatograph	ICMS	Integrated ceramic membrane system
H ₃ PO ₄	Phosphoric acid	ICP	Inductively coupled plasma
hr	Hour(s)	ICP-MS	Inductively coupled plasma mass spectrometry
HRL	HRL Laboratories, LLC	ICP-OES	Inductively coupled plasma optical emission spectroscopy
HRTEM	High-resolution transmission electron microscopy	ICR	Interfacial contact resistance
H ₂ S	Hydrogen sulfide	ID, i.d.	Internal diameter
HSC	Database name derived from the letters for enthalpy, entropy and heat capacity	IEA	International Energy Agency
HSDC	Hydrogen Secure Data Center	IEC	International Electrotechnical Commission
HSO ₄	Bisulfate anion	IEC	Ion exchange capacity
H ₂ SO ₄	Sulfuric acid	IEEE	Institute of Electrical and Electronics Engineers, Inc.
HSRP	Hydrogen Safety Review Panel	IEEE PVSC	IEEE Photovoltaic Specialists Conference
HT	High-temperature	IGCC	Integrated gasified combined cycle
HTE	High-temperature electrolysis		
H2TEC	Virginia-Maryland Hydrogen Technology Education Center		

IGT	Institute of Gas Technology	kb	Kilo-base pair, a unit of measurement used in genetics equal to 1,000 nucleotides
IIT	Illinois Institute of Technology		
IMECE	International Mechanical Engineering Congress and Expo	KBr	Potassium bromide
In	Indium	kcal	Kilocalorie(s)
In., in	Inch	kcal/mol	Kilocalorie(s) per mole
in ²	Square inch	KeV	Kilo electron volt(s)
INERI	International Nuclear Energy Research Initiative	kg	Kilogram(s)
		kg/day	Kilogram(s) per day
INL	Idaho National Laboratory	kg/hr	Kilogram(s) per hour
INMM	Institute for Nuclear Materials Management	kg/m ³	Kilogram(s) per cubic meter
		KH	Potassium hydride
InP	Indium phosphorus	kHz	Kilohertz
IP	Intellectual property	KIC	Key industrial collaborators
IPCE	Incident photon conversion to electrons	kJ	Kilojoule(s)
		kJ/mol	Kilojoule(s) per mole
IPE	Integrated photovoltaic electrolysis	km	Kilometer(s)
IPHE	International Partnership for the Hydrogen Economy	KMC	Kia Motors Corporation
		KOH	Potassium hydroxide
IPNS	Intense Pulse Neutron Scattering Facility at Argonne National Laboratory	kPa	Kilopascal(s)
		kph	Kilometer(s) per hour
		ksi	1,000 pound-force per square inch
IR	Infrared	kT/y	Kiloton(s) per year
Ir	Iridium	kW	Kilowatt(s)
iR	Internal resistance; voltage loss due to resistance	kWe	Kilowatt(s) electric
		kWh	Kilowatt-hour(s)
IRMOF	Isorecticular metal organic framework	kWh/kg	Kilowatt-hour(s) per kilogram
		kWh/L	Kilowatt-hour(s) per liter
IRR	Internal rate of return	kW/kg	Kilowatt(s) per kilogram
ISE	International Society of Electrochemistry	kWt	Kilowatt(s) thermal
		L, l	Liter(s)
ISO	International Organization for Standardization; International Standards Organization	La	Lanthanum
		LANL	Los Alamos National Laboratory
		LAO	Lanthanum-modified alumina
IT	Information technology	LAX	Los Angeles International Airport
ITM	Ion transport membrane	lb	Pound(s)
ITO	Indium tin oxide	lbmol	Pound-mole(s)
IUPAC	International Union of Pure and Applied Chemistry	LBNL	Lawrence Berkeley National Laboratory
I-V	Current-voltage	LCA	Life cycle assessment
J	Current	LCC	Lansing Community College
J	Joule(s)	LCC	La _{0.7} Ca _{0.3} CrO _{3-δ}
JM	Johnson Matthey	LCHPP	Low Cost Hydrogen Production Platform (DOE Program Title)
JPL	Jet Propulsion Laboratory		
K	Kelvin	L/D ratio	Ratio of length to diameter
K	Potassium	LDC	Local Distribution Company
kÅ	1000 angstroms	LDV	Light-duty vehicle
KAIST	Korea Advanced Institute of Science and Technology	LECO	Instrument for fixed oxygen determination
kA/m ²	Kilo-ampere(s) per square meter	LEED	Low-energy electron diffraction

LEEM	Low-energy electron microscopy	MAOP	Maximum allowable operating pressure
LEIS	Low-energy ion scattering	MARKAL	A generic, multi-sector energy model developed by the Energy Technology Systems Analysis Program of the International Energy Agency
LEL	Lower explosion limit		
LEMSYS	Local Energy Management System		
LERDWG	U.S. DOE Laboratory Energy R&D Working Group		
LES	Locally enhanced sampling	MAS-NMR	Magic angle spinning nuclear magnetic resonance
LFL	Lower flammability limit	MBE	Molecular beam epitaxy
L/h, l/h	Liter(s) per hour	MBL	Modified boundary layer
LH ₂	Liquid hydrogen	mC-cm ⁻²	MilliCoulomb(s) per square centimeter
LHC	Light-harvesting chlorophyll	MCEL	Millenium Cell, Inc.
LHS	Lawrence Hall of Science	MCFC	Molten carbonate fuel cell
LHV	Lower heating value	MD	Machine direction
Li	Lithium	MD	Molecular dynamics
LiBH ₄	Lithium borohydride	MDCA	Metal-doped carbon aerogels
LiH	Lithium hydride	MEA	Membrane-electrode assembly
Li ₃ N	Lithium nitride	MEI	Makel Engineering
LLC	Limited Liability Company	MEMS	Micro Electromechanical System
LLNL	Lawrence Livermore National Laboratory	MEMSYS	Micro-grid Energy Management System
LMDS	Laser modulation differential spectroscopy	MeOH	Methanol
L/min, l/min	Liter(s) per minute	meq	Milliequivalents
LNG	Liquefied natural gas	meq/g	Milliequivalents/gram
LP	Lattice parameter	MeV	Mega electron volt
LPG	Liquefied petroleum gas	Mg	Magnesium
LPM	Liters per minute	Mg	Megagram(s)
LSL	Lower specification limit	μg	Microgram(s)
LT	Low-temperature	mg	Milligram(s)
LTS	Low-temperature shift	Mg(OH) ₂	Magnesium hydroxide
LTU	Lawrence Technological University	mg/cm ²	Milligram(s) per square centimeter
LWR	Light water reactor	MgCl ₂	Magnesium chloride
LUMO	Lowest unoccupied molecular orbital	MgH ₂	Magnesium hydride
m	Meter(s)	MH	Metal hydride
M	Molar	MHCoE	Metal Hydride Center of Excellence
m ²	Square meter(s)	MHz	Megahertz
m ³	Cubic meter(s)	MI	Melt infiltration
m ² /g	Square meter(s) per gram	mi	Mile(s)
m ² /s	Square meter(s) per second	mi/kg	Mile(s) per kilogram
M31	Atofina membrane candidate	mil	Millimeter(s)
MA	Mechanical alloying	min	Minute(s)
mA	MilliAmps	MIT	Massachusetts Institute of Technology
μA	Micro ampere(s)	MJ	Megajoule(s)
mA/cm ²	Milliamp(s) per square centimeter	ML	Monolayer
μA/cm ²	Micro ampere(s) per square centimeter	mL, ml	Milliliter(s)
MACRS	Modified Accelerated Cost Recovery Schedule	μm	Micrometer(s); micron(s)
		μM	Micromolar

mM	Millimolar	MYRDDP	Multi-Year Research, Development and Demonstration Plan
mm	Millimeter(s)		
MMBtu	Million British thermal units	N	Normal (e.g., 1N H ₃ PO ₄ is 1 normal solution of phosphoric acid)
mmol	Millimole(s)		
μmol	Micromole(s)	N	Nitrogen
Mn	Manganese	N	Newton (unit of force)
MnO	Manganese oxide	N/cm ²	Newton(s) per square centimeter
Mn ₂ O ₃	Manganese oxide	N112	Nafion 1100 equivalent weight, 2 millimeter thick membrane
MOF	Metal organic framework		
Mo	Molybdenum	N ₂	Diatomic nitrogen
mol	Mole(s)	Na	Sodium
mol%	Mole percent	NA-22	National Nuclear Security Administration, Office of Non-Proliferation Research and Engineering
mol/min	Mole(s) per minute		
MoPc	Molybdenum phthalocyanine		
MPa	Megapascal		
MPG, mpg	Mile(s) per gallon	Na ₃ AlH ₆	Trisodium hexahydroaluminate
mph	Mile(s) per hour	NaAlH ₄	Sodium aluminum hydride; sodium tetrahydroaluminate; sodium alanate
MPL	Microporous layer		
MR	Membrane reactor	NaBH ₄	Sodium borohydride
MRI	Magnetic resonance imaging	NaBO ₂	Sodium borate
MRS	Materials Research Society	NACE	National Association of Corrosion Engineers
ms	Millisecond(s)		
mS/cm	Milli-Siemen(s) per centimeter	NaCl	Sodium chloride
MSHA	Mine Safety and Health Administration	NACS	North American Catalysis Society
		Nafion [®]	Registered Trademark of E.I. DuPont de Nemours
MSI	Metal-support interaction		
MSM	Macro-System Model	NaH	Sodium hydride
MSP	Molten state processing	NA NG	North American natural gas
MSRI	Materials and Systems Research, Inc.	NaOH	Sodium hydroxide
		Na ₂ S	Sodium sulfide
MST, MS&T	Materials Science and Technology	NAS	National Academy of Sciences
MSU	Montana State University	NASA	National Aeronautics and Space Administration
MTO	Mass transport overpotential		
μV	Micro volt(s)	NASA PERS	National Aeronautics and Space Agency Polymer Energy Rechargeable System
mV	Millivolt(s)		
mW	Milliwatt(s)		
MW	Megawatt(s)	NAU	Northern Arizona University
MW	Molecular weight	NAVSEA	Carderock Naval Sea Systems Command Carderock Division
mΩ	Milli-ohm(s)		
MΩ	Mega-ohm(s)	NAWC	Naval Air Warfare Center
mΩ/cm ²	Milli-ohm(s) per square centimeter	Nb	Niobium
μΩ-cm ²	Micro-ohm(s) - square centimeter	NCMS	National Center for Manufacturing Sciences
mW/cm ²	Milliwatt(s) per square centimeter		
MWe	Megawatt(s) electric	NCNR	NIST Center for Neutron Research
MWh	Megawatt-hour(s)	NCRC	New Concepts Research Corporation
MWOE	Midwest Optoelectronics, LLC		
MWth	Megawatt(s) thermal	ND	Not determined at this time
MYPP	Multi-Year Program Plan (the HFCIT Program's Multi-Year Research, Development and Demonstration Plan)	ND	Nitrogen donor
		NDA	Non-disclosure agreement
		NE	U.S. DOE Office of Nuclear Energy, Science and Technology

NEBS	Network Equipment Building Standards	NREL	National Renewable Energy Laboratory
NEC	NextEnergy Center	NSTF	Nanostructured thin film
NEC	National Electrical Code	NYSERDA	New York State Energy Research and Development Authority
NEED	National Energy Education Development Project	O	Oxygen
NEMS	National Energy Modeling System	O ₂	Diatomic oxygen
NERI	Nuclear Energy Research Initiative	O/C	Oxygen-to-carbon atomic ratio
NETL	National Energy Technology Laboratory	OCP	Open circuit potential
NEU	Northeastern University	OCV	Open circuit voltage
NFC	Near frictionless carbon	o.d.	Outer diameter
NFPA	National Fire Protection Association	OEC	Oxygen evolving complex
NG	Natural gas	OEM	Original equipment manufacturer
ng	Nanogram	OGA	Online gas analyzer
NGCC	Natural gas combined cycle	OH ⁻	Hydroxyl radical
NH ₃	Ammonia	O&M	Operation and maintenance
NHA	National Hydrogen Association	OMB	Office of Management and Budget
NHE	Normal hydrogen electrode	ONR	Office of Naval Research
NHI	Nuclear Hydrogen Initiative	OPS	Office of Pipeline Safety
NHTSA	National Highway Traffic Safety Administration of the U.S. Department of Transportation	ORF	Opening Reading Frame indicating the occurrence of a protein coding region in the DNA sequence
Ni	Nickel	ORNL	Oak Ridge National Laboratory
NICC	Natural gas Infrastructure Component Cost model	ORR	Oxygen reduction reaction
NiMH	Nickel metal hydride	OTM	Oxygen transport membrane
NIST	National Institute of Standards and Technology	OTT	Office of Transportation Technologies
NL	Normal liter(s)	ΔP	Pressure drop, pressure change
nm	Nanometer(s)	P	Phosphorus
NM	Noble metal	P	Pressure
Nm ³ /h, nm ³ /hr	Normal cubic meter(s) per hour	Pa	Pascal(s)
nmol	Nanomole(s)	PADD	Petroleum Administration for Defense District
NNA	Non-North American	PAFC	Phosphoric acid fuel cell
NNA NG	Non-North American natural gas	PANI	Polyaniline
NMR	Nuclear magnetic resonance	Pb	Lead
NMSU	New Mexico State University	PbA	Lead acid
NMTech	New Mexico Technological University	PBI	Polybenzimidazole
NO ₂	Nitric oxide	PbO	Lead oxide
N ₂ O	Nitrous oxide	PC	Polycarbonate
NO _x	Oxides of nitrogen	PC	Personal computer
NPC	Nanoporous carbon	Pc	Phthalocyanines (e.g., MoPc, FePc)
NPM	Non-precious metal	PCAMM	Pacific Centre for Advanced Materials and Microstructures
NPT	Normal pressure and temperature	PCF	Polycarbonate film
NPV	Net present value	PCM	Power control module
NRC	National Research Council	PCR	Polymerase chain reaction
		PCS	Power conditioning system

PCS	Plasma converter system	PMG	Glycidyl methacrylate-type copolymer
PCT, P-C-T	Pressure concentration temperature	PND	Polymerized nitrogen donor
Pd	Palladium	PNNL	Pacific Northwest National Laboratory
PDL	Polymer Data Library	POX	Partial oxidation
PDS	Potentiodynamic scan	ppb	Parts per billion
PDU	Process development unit	ppbv	Part(s) per billion by volume
PE	Polyethylene	PPI	Pore(s) per inch
PEAR	Power and Energy Analytic Resources	ppm, PPM	Part(s) per million
PEC	Photoelectrochemical	ppmv	Part(s) per million by volume
PECH	Polyepichlorohydrin	ppmw	Part(s) per million by weight
PEEK	Polyether ether ketone	Pr	Praseodymium
PEFC	Polymer electrolyte fuel cell	PRA	Probabilistic risk assessment
PEFC	Proton exchange fuel cell	PrOx	Preferential oxidation
PEI	Polyetherimide	PS	Photosystem
PEKK	Poly (ether ketone ketone)	PSA	Pressure swing adsorption
PEM	Polymer electrolyte membrane	PSAT	Vehicle simulation software package developed at Argonne National Laboratory - Power-train System Analysis Toolkit
PEM	Proton exchange membrane		
PEMFC	Polymer electrolyte membrane fuel cell		
PEMFC	Proton exchange membrane fuel cell	PSD	Particle size distribution
PEN	Positive-Electrolyte-Negative	psi, PSI	Pound(s) per square inch
PES	Polyether sulfone	psia	Pound(s) per square inch absolute
PES	Power electronics system	psid	Pound(s) per square inch differential
PES	Power Engineering Society	psig	Pound(s) per square inch gauge
PES	Proton Energy Systems, Inc.	PSI	Photosystem I
PET	Polyethylene teraphthalate	PSII	Photosystem II
PetF1	<i>Synechocystis</i> host ferredoxin	PSM	Plant support module
PFA	Perfluoroalkoxy (a type of fluoropolymer)	PSS	Potentiostatic scan
PFCT	Porvair Fuel Cell Technology, Inc.	PSU	Pennsylvania State University
PFD	Process flow diagram	PSU OPP	Pennsylvania State University, Office of Physical Plant
PFG-NMR	Pulse field gradient nuclear magnetic resonance	PSU PTI	Pennsylvania State University, Pennsylvania Transportation Institute
PFSA	Perfluorinated sulfonic acid		
PG	Propylene glycol	Pt	Platinum
PGM	Platinum group metal	P-T	Pressure-temperature
PI	Principal investigator	PTA	Phosphotungstic acid
pics	Measurement of how close together fibers are woven	Pt/C	Platinum/carbon
PID	Process identifier number	Pt ₃ Co	Platinum-cobalt alloy
PITTCON	Pittsburgh Conference and Exhibition for Analytical Chemistry	Pt ₃ Fe	Platinum-iron alloy
PI	Platinum	PTFE	Teflon – poly-tetrafluoroethylene
PLC	Programmable logic controller	Pt-FePO	Platinum iron phosphate
PLS	Polymer-layered silicate	Pt-MM	Platinum group mixed metal
PM	Precious metal, such as platinum	PTM	Proton transport membrane
PM ₁₀	Particulate matter with diameters of 10 micrometers or less	PtML	Platinum monolayer
P/M	Powder metallurgy	Pt ₃ Ni	Platinum-nickel alloy
		PTO	Power take-off
		PtO ₂	Platinum dioxide

Pt-TaPO	Platinum tantalum phosphate	SCE	Southern California Edison
PTW	Pump-to-wheel	SCE	Saturated calomel electrode
PUC	Public Utility Commission	SCF, scf	Standard cubic feet
PV	Photovoltaic	scfd	Standard cubic feet per day
PVC	Polyvinyl chloride	SCFH, scfh	Standard cubic feet per hour
PVDF	Polyvinylidene fluoride	SCFM	Standard cubic feet per minute
PVP	Polyvinylpyrrolidone	SCIA	South Central Industrial Association
PVT, P-V-T	Pressure-Volume-Temperature	S/cm	Siemen(s) per centimeter
Q1, Q2, Q3, Q4	Quarters of the fiscal year	SD	Standard deviation
RA	Reduction in area	SDAPP	Sulfonated Diels-Alder polyphenylene
R&D	Research and development	SDAPPe	Sulfonated Diels-Alder ether
RD&D, R,D&D	Research, development & demonstration	SDE	SO ₂ -depolarized electrolyzer
RDE	Rotating disk electrode	SDO	Standards Development Organization
Re	Rhenium	Se	Selenium
REWP	Renewable Energy Working Party	sec	Second(s)
RF	Radio frequency	SECA	Solid State Energy Conversion Alliance
RFC	Regenerative fuel cell	SEM	Scanning electron microscopy
RFP	Request for proposals	SEM	Secondary electron microscopy
RH	Relative humidity	SEMaC	Smart Energy Management Controller
Rh	Rhodium	SEP	Subscale engineering prototype
RHE	Reference hydrogen electrode; reversible hydrogen electrode	SERC	Schatz Energy Research Center
RHLC	Relative humidity/load cycle test	SF ₆	Sulfur hexafluoride
RPI	Rensselaer Polytechnic Institute	SFA	Sulfonic acid
rpm	Revolution(s) per minute	S-G	Secretary-General
RRDE	Rotating ring disc electrode	SHE	Standard hydrogen electrode
RSOFC	Regenerative solid oxide fuel cell	SHGR	Solar Hydrogen Generation Research
RT	Room temperature	Si	Silicon
RTC	Regional Transportation Commission	S-I	Sulfur - iodine
Ru	Ruthenium	SiC	Silicon carbide
s	Second(s)	SIMS	Secondary ion emission spectroscopy
S	Siemen(s)	SiO ₂	Silicon dioxide
S	Sulfur	SLPM, SLM, sL/min	Standard liter(s) per minute
SA	Surface area	SM	Surface modifier
SAE	Society of Automotive Engineers	SMAE	Solid membrane alkaline electrolyzer
SAH	Sodium aluminum hydride	SME	Mercury sulfate electrode
SAM	Scanning Auger microscopy	SMR	Steam methane reformer; steam methane reforming
SAMPE	Society for the Advancement of Material and Process Engineering	Sn	Tin
SAT	Site acceptance test	SNL	Sandia National Laboratories
SAXS	Small angle x-ray scattering analysis	SNLL	Sandia National Laboratory Livermore
SBIR	Small Business Innovative Research	SnO	Tin oxide
SBP	Solution based processing		
Sc	Scandium		
S/C	Steam to carbon ratio		
SCC	Stress corrosion cracking		
sccm, SCCM	Standard cubic centimeter(s) per minute		

SnO ₂	Tin oxide	TAP	Tandem affinity purification
SO ₂	Sulfur dioxide	TaPO	Tantalum phosphate
SO ₃	Sulfur trioxide	TBD	To be determined
SOC	State of charge	TBX	Turboexpander
SOEC	Solid oxide electrolysis cell; solid oxide electrolyzer cell	TC	Thermocouple
SOFC	Solid oxide fuel cell	TC	Thermochemical
SOFEC	Solid oxide fuel-fed electrolysis cell	TC	Technical Committee
SOM	Solid-oxide oxygen-ion-conducting membrane	TCCR	Transparent, conducting and corrosion resistant
SOO	Statement of Objectives	TCWC	Thermochemical water cracking
SORFC	Solid oxide regenerative fuel cell	TD	Transverse direction
SO _x	Oxides of sulfur	Te	Tellurium
SPEKK	Sulfonated polyether ether ketone	TEAB	Tetraethyl ammonium borohydride
SPR	Solid particle receiver	TEM	Transmission electron microscopy
sq. in.	Square inch(es)	TESI	Teledyne Energy System Inc.
Sr	Strontium	TFMSA	Trifluoromethane sulfonic acid
SR	Steam reformer; steam reforming	tf-Si	Thin film silicon
SRM	Steam reforming	Tg	Glass transition temperature
SRM	Standard reference material	TGA	Thermal gravimetric analysis; thermogravimetric analysis; thermal gravimetric analyzer
SRNL	Savannah River National Laboratory		
SS	Stainless steel	TGC	Tail gas combustor
SSA	Specific surface area	TGP-H	Toray graphite paper - high conductivity
SSP	Solid state processing		
SSR	Spiral stackable reactor	THC	Total hydrocarbons
SSRL	Stanford Synchrotron Radiation Laboratory	THF	Tetrahydrofuran
STA	Silicotungstic acid	Ti	Titanium
STAC	State Technologies Advancement Collaborative	TiCl ₃	Titanium trichloride
STD	Soon to demonstrate	TiF ₃	Titanium trifluoride
STEM	Scanning transmission electron microscopy	TiH ₂	Titanium hydride
STH	Solar-to-hydrogen	TiO ₂	Titanium dioxide (anatase)
STM	Scanning tunneling electron microscopy	TIVM	Toroidal intersecting vane machine
STP	Standard temperature and pressure	Tla	Truncated light-harvesting chlorophyll antenna
STTP	Shared Technology Transfer Project	tla1	Mutant of the Tla1 gene (GenBank Assession No. AF534570)
STTR	Small Business Technology Transfer	tlaX	Mutant of unknown gene with a truncated light-harvesting chlorophyll antenna (GenBank Assession No. AF534571)
SUNY	State University of New York		
SV	Space velocity	TM	Transition metal
SWCNT	Single-walled carbon nanotube	TMPP	Tetramethoxyphenyl porphyrins
SWNH	Single-walled nanohorn	TMS	The Minerals, Metals and Materials Society
SWNT	Single-walled nanotube		
SwRI	Southwest Research Institute	TOS	Time on stream
T	Temperature	TPD	Tons per day
T	Ton	TPD	Thermally programmed desorption; Temperature-programmed desorption
t	Time		
Ta	Tantalum		
TAG	Technical Advisory Group	TPO	Temperature-programmed oxidation

TPP	Tetraphenyl porphyrin	UTC	University of Tennessee, Chattanooga
TPR	Temperature-programmed reduction	UTR	Untranslated region
TRL	Technology readiness level	UTRC	United Technologies Research Center
tr. oz.	Troy ounce	UV	Ultraviolet
TRU	Trailer refrigeration unit	UV-vis	Ultraviolet-Visual
TSA	Transportation Security Administration	UW	University of Washington
TSSER	Thermal swing sorption enhanced reaction	V	Vanadium
TT	Thermal treatment	V	Volt
TWM	Thermal and water management	VAC	Volts alternating current
UC	University of California	VASP	Vienna Ab-initio Simulation Package
UCI	University of California, Irvine	VaTech	Virginia Polytechnic Institute and State University
UCLA	University of California, Los Angeles	VC	Vulcan carbon
UCONN	University of Connecticut	VDC	Volts direct current
UCSB	University of California, Santa Barbara	vdW	van der Waals
UEA	Unitized electrode assembly	VF	Value function
UGA	University of Georgia, Athens	VHTS	Virtual high-throughput screening
UH	University of Hawaii	V-I	Voltage - current
UHV	Ultra-high vacuum	VIR	Voltage - current - resistance
UIUC	University of Illinois, Urbana- Champaign	VMT	Vehicle miles travelled
UL	Underwriters Laboratory	VNT	Variable nozzle turbine
ULSD	Ultra-low sulfur diesel	vol	Volume
um	Micrometer(s)	vol%	Volume percent
UMCP	University of Maryland College Park	VTA	Valley Transportation Authority
UN	United Nations	VTGR	Very high temperature gas reactor
UNC	University of North Carolina	VTNA	Volvo Trucks North America
UNLV	University of Nevada Las Vegas	Ω	Ohm(s)
UNLVRF	UNLV Research Foundation	W	Tungsten
UNM	University of New Mexico	W	Watt(s)
UNR	University of Nevada, Reno	WAXD	Wide-angle x-ray diffraction
UPS	Ultraviolet photoelectron spectroscopy	WBS	Work breakdown schedule
U.S.	United States	Ωcm^2	Ohm(s) - square centimeter
USA	United States of America	W/cm^2	Watt(s) per square centimeter
USC	University of South Carolina	We	Watt(s) electric
USC	University of Southern California	WGS	Water gas shift
USCAR	U.S. Cooperative Automotive Research	WGS-MR	Water gas shift membrane reactor
USFCC	United States Fuel Cell Council	Wh	Watt-hour(s)
USL	Upper specification limit	W-h/kg	Watt-hour(s) per kilogram
USM	University of Southern Mississippi	W-h/L, Wh/liter, Wh/L	Watt-hour(s) per liter
USP	Ultrasonic spray pyrolysis	WHSV	Weight hourly space velocity
UT	University of Toledo	W/kg	Watt(s) per kilogram
UTC, UTC FC	United Technologies Corporation Fuel Cells	W/L, W/l	Watt(s) per liter
		W/m-K, W/m.K, W/mK	Watt(s) per meter-Kelvin (unit of thermal conductivity)
		WO_3	Tungsten trioxide

WOM	Weatherometer
Wt	Watt(s) thermal
wt	Weight
wt%, wt.%	Weight percent (percent by weight)
WTP	Water transfer plate
WTP	Well-to-pump
WTW	Well-to-wheel
w/v	Weight by volume
XAS	X-ray absorption spectroscopy
XPS	X-ray photoelectron spectroscopy
XRD	X-ray diffraction
XRF	X-ray fluorescence
Y	Yttrium
yr	Year
YSZ	Yttria-stablized zirconia
Zn	Zinc
ZnO	Zinc oxide
Zr	Zirconium
ZrO ₂	Zirconium dioxide

